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The effects of superset configuration on kinetic, kinematic, and perceived exertion in the barbell bench press

Running Head: Superset configuration and kinetic, kinematic, and perceived exertion

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ABSTRACT

Training that is efficient and effective is of great importance to an athlete. One method of improving efficiency is by incorporating supersets into resistance training routines. However, the structuring of supersets is still unexplored. Therefore, the purpose of this study was to assess the effects of agonist-antagonist (A-A), alternate peripheral (A-P), and similar biomechanical (SB) superset configurations on rate of perceived exertion (RPE), kinetic and kinematic changes during the bench press. 10 subjects performed resistance training protocols in a randomized-crossover design, with magnitude-based inferences assessing changes/differences within and between protocols. Changes in RPE were *very likely* and *almost certainly* greater in the A-P and SB protocols when compared with the A-A, while all superset protocols had *very likely* to *almost certain* reductions in mean velocity and power from baseline. Reductions in mean velocity and power were almost certainly greater in the SB protocol, with differences between the A-A and A-P protocols being *unclear*. Decreases in peak force were *likely* and *almost certain* in the A-A and SB protocols respectively, with changes in A-P being *unclear*. Differences between these protocols showed likely greater decreases in SB peak forces when compared to A-A, with all other superset comparisons being *unclear*. This study demonstrates the importance of exercise selection when incorporating supersets into a training routine. It is suggested that the practitioner uses A-A supersets when aiming to improve training efficiency and minimize reductions in kinetic and kinematic output of the agonist musculature while completing the barbell bench press.

Key words: Perceived exertion; velocity; power; force

INTRODUCTION

Resistance training is a well-established method of improving muscular strength, power, and hypertrophy (9, 28). Resistance training has been shown to be a safe method of training in athletes (14, 24), and can reduce the risk of injury when appropriately implemented (15). However, athletes are often unable to commit large periods of time to resistance training due to other training requirements (e.g. skill development, conditioning, team practice) and the large amount of variability within a training week (40). Therefore, it is important that training is time efficient. One method that has been shown to enhance resistance training efficiency while maintaining efficacy is the application of resistance training supersets (SS) (29). This method refers to the grouping of exercises so that two different exercises are completed consecutively, followed by a rest period (e.g. a squat and bench press followed by a rest interval). By strategically removing recovery between sets, reductions in training time have been shown to occur while training volume (e.g. total amount of weight lifted (Kg)) is maintained (30, 41).

Within the literature (31), three forms of SS configuration have been defined, with agonist-antagonist (A-A) pairings (e.g. bent-over row and bench press) being the most commonly investigated (4, 5). Nevertheless, alternate peripheral (A-P) (e.g. back squat and bench press) and similar biomechanical (SB) movements (e.g. dumbbell bench press and barbell bench press) have also been examined (7, 41). However, these different exercise groupings have not been compared despite evidence suggesting conflicting resistance training outcomes (e.g. in the bench press throw exercise, A-A pairings caused acute increases of 4.7% in mean power output (4), while SB demonstrated acute decreases in peak velocity of 10.7% (33)). Consequently, the effect of SS configuration on resistance training is still unknown.

While SS are known to improve training efficiency (41), neuromuscular function may be impacted when using this method. Previous research (27, 28) has shown the importance of maintaining high levels of kinetic (e.g. force) and kinematic (e.g. velocity and power) outputs when aiming to develop muscle size, strength, and power. However, Weakley et al. (41) has demonstrated that SS may cause greater losses in these variables when compared to traditional (i.e. one exercise set followed by a rest) resistance training. It was shown that SS can cause large reductions in lower body power (e.g. countermovement jump height) 24 hours post training (effect size (ES) ±90% confidence interval (90% CI); SS: -0.29 ± 0.19 vs. traditional: 0.01 ± 0.19), with these changes attributed to increased metabolic perturbation causing reduction in force-generating capabilities. Furthermore, these reductions in neuromuscular function were also accompanied by increased rating of perceived exertion (RPE) (41). These increases in RPE have shown near perfect relationships with metabolic responses (41) and may provide additional insight into kinematic changes when resistance training (34). However, it has previously been postulated that by manipulating SS exercise order and exercise selection, kinetic, kinematic, and RPE outcomes may be positively affected (4). These changes have been suggested to occur due to changes in motor unit recruitment (3), varying rates of localized muscle fatigue (7), and / or alterations in the triphasic neural pathways (4). Nevertheless, further research is still required to assess the influence of varying SS configurations on neuromuscular outcomes.

Existing research has assessed the effects of differing forms of SS on bench press kinetic and kinematic outputs (4, 30, 32), RPE (5, 41), and resistance training volume (5, 30). However, no study has compared the effects of these different forms of SS configuration on bench press outcomes when resistance training. Furthermore, it is unknown whether these different arrangements of SS alter perceptions of perceived exertion. Therefore, due to the importance of kinetic and kinematic outputs when training to develop muscle size, strength, and power (27, 28), the aim of this study was to assess the effects of differing SS arrangement on kinetic, kinematic, and RPE changes during the bench press exercise.

METHODS

Experimental approach to the problem

To assess the effects of three different forms of SS arrangement on kinetic, kinematic, and RPE outcomes in the barbell bench press, 10 sub-elite adult rugby union players completed four exercise protocols in a randomized-crossover design, with at least 7 days between each testing session. The four resistance training protocols consisted of one set of the barbell bench press followed by a five minute recovery period then either; 1) control (CON): three further sets of the barbell bench press with a two minute recovery period between sets; 2) A-A: three SS of the bent-over row and the barbell bench press with two minute rest periods; 3) A-P: three SS of the back squat and the barbell bench press with two minute rest periods; 4) SB: three SS of the dumbbell bench press and the barbell bench press with two minute rest periods. All repetitions were completed without assistance. Exercises were completed at 65% of three repetition maximum (3RM) as this intensity has been found to be near maximal when performing SS (33) and has previously been utilized in literature investigating this training method (41). A linear position transducer (GymAware, Kinetic Performance Technology, Canberra, Australia) was used to record kinetic and kinematic outcomes due to their importance while resistance training (28), while RPE was reported 15 minutes after the completion of each protocol owing to its validity as an internal measure of training load and relationship with metabolic outcomes (17, 41).

Subjects

10 male rugby players (mean ± standard deviation (SD); age: 20.9 ± 9.6 years; height: 183.2 ± 6.1 cm; body mass: 90.2 ± 9.6 kg; 3RM barbell bench press: 114.3 ± 10.3 kg; 3RM back squat: 139.7 ± 27.9 kg; 3RM bent-over row: 101.1 ± 12.0 kg; 3RM dumbbell bench press: 87.5 ± 11.6 kg), who had at least two years resistance training experience (3.9 ± 1.2 years) were recruited from a university rugby union team from the United Kingdom. Testing took place in February (which is within the second half of the university rugby playing calendar). All subjects confirmed that they did not have any current injuries, have not or do not consume any medications or supplements that could influence performance, and that they were not suffering from any diseases. Subjects were explained the design of the study, provided an opportunity to ask questions and then provided informed written consent. All experimental procedures were approved by Leeds Beckett University's ethics committee and written assent was provided by all subjects.

Experimental Procedures

All testing was conducted at the same time of day one week apart, with subjects being asked to refrain from physical activity for the 48 hours prior to all testing procedures. Subjects were instructed to maintain normal dietary habits in the 24 hours prior to testing, with caffeine not being consumed in the 12 hours before. All subjects were screened prior to acceptance into the study (38), followed by anthropometric and 3RM strength assessment of the barbell bench press, back squat, bent-over row, and dumbbell bench press. Subjects were randomized to complete four testing sessions (i.e. CON, A-A, A-P, and SB) with session order designated through computer-generated random numbering (37). All exercise protocols consisted of a standardized warm-up, which consisted of dynamic movements and exercise specific stretches, and a set of 10 repetitions of the bench press at 65% of 3RM performed as explosively as possible prior to the experimental trials (i.e. CON, A-A, A-P, and SB). This indicated the subject's baseline performance on that day. After a five-minute recovery period, subjects then completed their scheduled protocol. During all repetitions and sets of the barbell bench press, a linear position transducer (Kinetic Performance Technology, Canberra, Australia) was attached which calculated peak force (i.e. the highest force value recorded between two sampling points) and mean velocity and power (i.e. the overall velocity and power output across the whole concentric range of motion) (19). These variables were used due to their high level of reliability and validity (i.e. coefficient of variation <5% (6)) and previous use in the barbell bench press (10). Following all exercise protocols RPE was reported using a modified Borg category ratio-10 scale (16)

3RM strength assessments testing

The assessment of 3RM strength was completed as this is regularly used within similar cohorts and has been used in the prescription of SS training methods (39-41). 3RM strength testing of the barbell bench press, back squat, bent-over row, and dumbbell bench press was completed during a familiarisation session after acceptance into the study. These exercises were chosen due to the subjects' familiarity with these movements and their previous use in rugby union research (11, 39, 40). 3RM strength of each exercise was assessed using the following protocols which have previously been used to assess strength (39-41). The bench press was completed with hand position at a self-selected width which was recorded and replicated across conditions. The bar was lowered to the chest and returned to a locked-out position to complete the repetition. The back squat was completed with the bar resting on the upper trapezium with subjects required to lower themselves so that the top of the thigh was parallel with the floor; as determined by the lead researcher. The bent-over row was completed with an overhand grip which raised the bar to the lower sternum; while the torso was maintained parallel to the ground. The dumbbell bench press begun with the subject lying flat on a bench with the arms holding both dumbbells so that the elbow was at a 90-degree angle. The arms were extended so that the dumbbells were directly over the subject's chest and then returned to the start position.

Superset and control protocols

All protocols used the barbell bench press as an outcome measure, with SS protocols requiring the completion of an exercise immediately prior, while the CON protocol completed a single set of the bench press. All exercises (i.e. barbell bench press, back squat, bent-over row, and dumbbell bench press) were loaded with a weight that was 65% of 3RM. This intensity was selected for the protocols as it has previously been established that when completing SS, intensities above this cause notable losses in repetition completion (i.e. 12.5%) (33). Furthermore, this is consistent with recent literature (41) which has investigated the physiological responses of rugby union players. Each repetition required subjects to complete a two second eccentric action, while the concentric portion of each exercise was required to be as "forceful and as powerful as possible" (18, 28). Furthermore, each exercise consisted of three sets of 10 repetitions, apart from the barbell bench press which had a fourth set that was completed at baseline.

Kinematic and Kinetic Assessment

Assessment of mean velocity, mean power, and peak forces of the bench press were recorded with a GymAware® optical encoder which sampled at 50Hz (Kinetic Performance Technology, Canberra, Australia). The optical encoder, which was placed directly below the barbell bench press exercise, contains a retractable cord that was attached to the barbell during each set for each subject. Velocity and displacement are calculated from the rotation of a pulley system within the optical encoder upon the movement of the barbell during the exercise (2). The encoder, which has previously been assessed as highly valid for reporting of velocity, power, and force (6), provides approximately one electrical impulse every three millimetres of barbell displacement with each value time stamped with a one-millisecond resolution. To assist in the calculation of the variables (i.e. power and force), barbell mass and additional weight are inputted by the lead researcher before each trial (2, 12).

RPE Measures

Subjects were asked to rate their perceived exertion 15 minutes after each resistance training protocol after being asked the question "How was your workout?". Subjects were supplied the modified-Borg Scale and verbally indicated an answer which was recorded. This has previously been shown to have a high level of reliability in differing resistance training protocols (36).

Statistical analyses

Data are presented as either mean ± SD or percentage/effect size (ES) ± 90% confidence intervals (90% CI) where specified. Prior to analysis, all data were log-transformed to reduce bias arising from non-uniformity error, and then analysed for practical significance using magnitude-based inferences (21). The chance of the RPE, mean concentric velocity, power, or peak force being lower, similar, or greater than the smallest worthwhile change/difference (SWC/D) (i.e. 0.2 x between subject difference) was calculated using an online spreadsheet (23), with all between group comparisons of effects being further analysed using a separate spreadsheet (22). The probability that the magnitude of change was greater than the SWC/D was rated as <0.5%, *almost certainly* not; 0.5-5%, very un*likely*; 5-25%, un*likely*; 25-75%, possibly; 75-95%, *likely*; 95-99.5%, *very likely*; >99.5%, *almost certainly* (21). Where the 90% Confidence Interval (CI) crossed both the upper and lower boundaries of the SWC (ES±0.2), the magnitude of change was described as *unclear* (21). ES thresholds were set at <0.2 (*trivial)*, 0.2-0.6 (*small*), 0.6-1.2 (*large)*, and 1.2-2.0 (*very large*) (21).

RESULTS

Data are presented for mean (±SD) concentric velocity, power, and concentric peak force (Table 1) of the barbell bench press in the CON and three SS protocols. Also provided are the ES (±90%CI), inference of change from baseline, and between condition comparison of ES change from baseline to set three (ES ±90%CI and inference) across all conditions.

Insert table 1 here

RPE (mean ± SD) in the CON (2.9 ± 0.8), A-A (4.0 ± 0.5), A-P (5.1 ± 0.8), SB (8.2 ± 0.7), were found. All three SS protocols had *almost certainly* greater mean RPE values than the CON, while the A-P condition had a *very likely* greater RPE when compared to the A-A protocol. The SB protocol had an *almost certainly* greater RPE compared to both the A-A and A-P protocols.

DISCUSSION

The purpose of the current study was to assess and compare the effects of three different SS configurations on kinetic, kinematic, and RPE responses across 3 sets during the bench press exercise. Of the three SS configurations, mean concentric velocity and power were reduced to the greatest extent from baseline in the SB condition with *almost certainly* greater reductions in this protocol when compared to the A-A and A-P pairings. Furthermore, when compared to baseline, changes in peak force were *unclear* in the traditional and A-P condition, while *likely* and *almost certain* reductions were reported in the A-A and SB complexes, respectively. Comparisons between protocols demonstrated *likely* greater reductions in peak force in SB when compared with A-A. However, differences between SB and A-P were *unclear*. Finally, results revealed that the A-A pairing had *very likely* and *almost certainly* lower RPE than the A-P and SB pairings, respectively.

The current study establishes the importance of SS configuration on resistance training responses. Velocity loss from baseline to the final set occurred across all conditions, with *moderate* changes in the CON (ES ± 90% CI; -0.62 ± 0.29) and A-A (ES ± 90% CI; -0.91 ± 0.41), and *large* (ES ± 90% CI; -1.45 ± 0.88) to *very large* (ES ± 90% CI; -6.17 ± 0.57) reductions in the A-P and SB. While *possible* and *likely* differences were evident when CON was compared with the A-A and A-P protocols, respectively, it is of note that *unclear* differences were evident between the two latter conditions. This *unclear* result is partially attributed to the large amount of uncertainty around the mean loss in velocity in the A-P pairing. It is speculated that this uncertainty is due to varying tolerance of the large metabolic cost of completing the back squat immediately followed by the bench press (40). With near perfect relationships between measures of fatigue (e.g. lactate and ammonia accumulation) (r = 0.95-0.97) and velocity loss in the barbell bench press (34), subjects with greater lower body work capacity may have shown improved tolerance to this form of SS configuration. Therefore, a high level of work capacity may be required to reduce loss of kinematic outcomes in SS complexes that incorporate the lower body and its large component of lean body mass.

The *very large* losses of velocity reported in the SB protocol were *almost certainly* greater than reductions in all other protocols. Previous research (18) has shown that repeated high-intensity muscle contractions can reduce substrate availability and increase metabolic accumulation. These changes can cause acute reductions in muscle performance which have been shown to impede moderate term (i.e. 8 weeks) strength and power development (28). However, greater reductions in barbell velocity across these time frames have been related to increased muscle hypertrophy (28). This promotes the idea that SS complexes that pair exercises of a similar nature may not be ideal for the development of strength and power (8, 28, 31), yet may assist in the development of lean body mass due to responses related to increased peripheral fatigue (31, 35). However, longitudinal research investigating this is still required to elucidate these mechanisms and changes.

Accompanying the previously reported decreases in velocity, were almost identical losses in power in the SS protocols (see table 1). However, the *moderate* (A-A), *large* (A-P), and *very large* (SB) decreases in power from baseline do not mirror the much smaller changes in peak force production. This suggests that the implementation of SS resistance training causes reduction in power output primarily due to decreases in velocity rather than force, with these changes in velocity most likely attributed to mitigated shortening speeds of muscle fibers and the slowing of muscle relaxation (1). While reductions in peak forces do occur, albeit to a lesser extent than mean velocity and power, these smaller changes may be due to an increase in motor unit efficiency in the triceps brachii (3). Artur et al. (3) have demonstrated the additional recruitment of higher threshold motor units when fatigue is induced prior to the bench press exercise. However, it should be noted that this increased motor unit recruitment may not promote long-term improvements in force and power (25, 26, 28). The practitioner and sports scientist may therefore be cautious in the selection of SB pairings due to the large amounts of localized fatigue, declines in kinetic and kinematic variables, and the mechanisms that are utilized to maintain performance.

The current study also acknowledges the importance of SS configuration on perceived intensity, with the A-A pairing reporting lower RPE when compared with A-P and SB. While this study is not the first to assess SS configuration and RPE (5), it is the first to compare supersets that extend beyond the agonist and antagonist format. It is speculated that the greater range of movement and muscle mass utilized in the A-P SS (13), and the increased localized muscle fatigue and subsequent substrate depletion in the SB protocol (8), increased RPE and impacted performance. This indicates that perceived intensity may not only be related to exercise choice or intensity, but total work completed (i.e. displacement of the external load) and the total volume each muscle group completes (20). Therefore, when implementing SS, consideration should be given to the movement pattern and range of motion each exercise requires and how this can impact upon perceived measures of training load.

While this study is the first to assess and compare the varying effects of different SS configuration, it is not without its limitations that might reduce transferability to application. First, while the definition of different forms of SS have been referred to in numerous publications (3, 8, 31), the formulation of each SS complex within a defined category can occur in a large variety of ways (41). This includes exercise selection (e.g. multi-joint/isolated), order, intensity (as a percentage of 1RM), range of motion, and recovery allotted between subsequent sets. It is therefore crucial that the practitioner and sport scientist consider these training variables when designing relevant SS interventions. Secondly, due to the nature of the research question, the outcomes of this study were being assessed within a singular exercise (i.e. barbell bench press). Previous research has assessed neuromuscular and metabolic responses across acute and short-term time periods (41). However, further research is required to assess the outcomes of longitudinal research investigating varying configurations of SS complexes. Finally, it is acknowledged that kinetic and kinematic responses demonstrated in the current study may be exercise and loading specific. Complexes of a similar nature may vary due to muscle mass utilized (34), terminal concentric velocity of individual exercises (18), contribution of the stretch-shortening cycle (13), and the relative "sticking region" of each exercise (34). These findings therefore need to be interpreted with caution for exercises other than the barbell bench press.

In conclusion, the current study demonstrates the kinetic, kinematic and perceived exertion responses to differing SS structures. The findings suggest that SS configuration can induce varying levels of acute fatigue, with movements that are of a SB nature resulting in the largest decline in performance. Additionally, resistance training that utilizes A-A and A-P may demonstrate similar changes in performance outcomes. However, due to the large amount of deviation in individual responses to A-P, as well as the *very likely* smaller change in rate of perceived exertion in the A-A condition, protocols that integrate "*pull-push*" SS complexes may be favourable in time constrained periods. Finally, TRAD training structures that incorporate increased recovery may be most beneficial when training objectives are to maximize movement velocity and power. Future research should endeavour to apply the above findings and assess how these results can enhance training outcomes.

Practical Application

The ability to spend prolonged amounts of time training is often not feasible for an athlete. Therefore, structures that enhance training efficiency by decreasing training time should be considered. The implementation of SS is a unique training method that can enhance resistance training efficiency, with A-A and A-P configurations both appearing to minimize declines in kinetic and kinematic outcomes when compared with SB. Consequently, these configurations should be utilized when aiming to reduce recovery interval frequency, or when large amounts of training volume are required (e.g. muscular endurance/hypertrophy mesocycles). Furthermore, the use of A-A SS may mitigate increases in perceived exertion which may be beneficial during these training phases. However, the selection of SS configuration may depend upon the desired training outcome and it should be noted that traditional resistance training methods (i.e. singular sets) were superior in the maintenance of velocity, power, and force. Therefore, when resistance training quality (i.e. high levels of kinetic and kinematic outputs) is of the highest importance (e.g. during the development of power) traditional methods may be of the greatest benefit.

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Table 1. Within and between condition comparison of barbell bench press mean velocity ($m \cdot s^{-1}$), power (W), and peak force (N) across traditional and superset resistance training protocols

	Baseline M ± SD	Set 1 M ± SD	Baseline – Set 1 ES ± 90% CI Inference	Set 2 M ± SD	Baseline – Set 2 ES ± 90% CI Inference	Set 3 M ± SD	Baseline – Set 3 ES ± 90% CI Inference	Baseline – Set 3 Between condition comparison ES ± 90% CI / Inference
Mean Velocity ($m \cdot s^{-1}$)								
Control	0.70 ± 0.10	0.70 ± 0.10	0.01 ± 0.21 *Likely trivial*	0.67 ± 0.10	-0.25 ± 0.24 *Possibly* ↓	0.64 ± 0.09	-0.62 ± 0.29 *Very likely* ↓	-0.29 ± 0.46 / A-A *possibly* greater ↓ -0.83 ± 0.90 / A-P *likely* greater ↓ -5.55 ± 0.94 / SB *almost certainly* greater ↓
Agonist-antagonist	0.70 ± 0.13	0.68 ± 0.15	-0.18 ± 0.19 *Possibly* ↓	0.64 ± 0.18	-0.51 ± 0.32 *Likely* ↓	0.59 ± 0.19	-0.91 ± 0.41 *Very likely* ↓	-0.54 ± 0.94 / A-A and A-P *Unclear* -5.26 ± 0.67 / SB *almost certainly* greater ↓
Alternate peripheral	0.70 ± 0.09	0.67 ± 0.13	-0.23 ± 0.39 *Possibly* ↓	0.61 ± 0.15	-0.89 ± 0.59 *Very likely* ↓	0.57 ± 0.16	-1.45 ± 0.88 *Very likely* ↓	-4.72 ± 1.00 / SB *almost certainly* greater ↓
Similar Biomechanical	0.74 ± 0.09	0.54 ± 0.15	-2.63 ± 0.74 *Almost certain* ↓	0.43 ± 0.15	4.66 ± 1.03 *Almost certain* ↓	0.36 ± 0.07	-6.17 ± 0.57 *Almost certain* ↓	
Mean Power (W)								
Control	509 ± 66	510 ± 68	-0.02 ± 0.22 *Unclear*	492 ± 62	-0.26 ± 0.26 *Possibly* ↓	485 ± 118	-0.36 ± 0.54 *Possibly* ↓	-0.63 ± 0.67 / A-A *possibly* greater ↓ -1.24 ± 1.14 / A-P *likely* greater ↓ -7.37 ± 0.89 / SB *almost certainly* greater ↓
Agonist-antagonist	507 ± 87	488 ± 101	-0.22 ± 0.21 *Possibly* ↓	458 ± 109	-0.59 ± 0.35 *Very likely* ↓	425 ± 121	-1.02 ± 0.45 *Almost certain* ↓	-0.61 ± 1.11 / A-A and A-P *Unclear* -6.74 ± 0.85 / SB *almost certainly* greater ↓
Alternate peripheral	501 ± 62	482 ± 92	-0.31 ± 0.52 *Unclear*	440 ± 100	-1.02 ± 0.73 *Very likely* ↓	407 ± 111	-1.63 ± 1.05 *Very likely* ↓	-6.13 ± 1.23 / SB *almost certainly* greater ↓
Similar Biomechanical	539 ± 51	398 ± 117	-3.08 ± 1.16 *Almost certain* ↓	303 ± 101	-5.83 ± 1.26 *Almost certain* ↓	250 ± 47	-7.76 ± 0.76 *Almost certain* ↓	
Peak Force (N)								
Control	1258 ± 126	1271 ± 146	0.10 ± 0.25 *Possibly trivial*	1295 ± 170	0.28 ± 0.33 *Possibly* ↓	1286 ± 170	0.21 ± 0.42 *Unclear*	-0.59 ± 0.83 / CON and A-A *unclear* -0.73 ± 0.85 / A-P *likely* greater ↓ -1.39 ± 0.59 / SB *almost certainly* greater ↓
Agonist-antagonist	1381 ± 191	1365 ± 225	-0.08 ± 0.13 *Likely trivial*	1341 ± 209	-0.21 ± 0.18 *Possibly* ↓	1309 ± 212	-0.38 ± 0.22 *Likely* ↓	-0.14 ± 1.03 / A-A and A-P *Unclear* -0.80 ± 0.85 / SB *likely* greater ↓
Alternate peripheral	1349 ± 225	1355 ± 215	0.02 ± 0.19 *Likely trivial*	1313 ± 215	-0.16 ± 0.22 *Possibly* ↓	1235 ± 211	-0.52 ± 0.77 *Unclear*	-0.66 ± 0.86 / A-P and SB *unclear*
Similar Biomechanical	1447 ± 139	1329 ± 193	-0.85 ± 0.38 *Very likely* ↓	1310 ± 145	-0.99 ± 0.33 *Almost certain* ↓	1286 ± 1285	-1.18 ± 0.46 *Almost certain* ↓	

M ± SD: Mean ± standard deviation. ES: Effect size. 90% CI: 90% confidence interval. ↑: increase. ↓: decrease. CON: control. A-A: agonist-antagonistic pairing; A-P: alternate peripheral pairing; S-B: similar biomechanical pairing.